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DARBY & DARBY P.C.
805 Third Avenue
New York, New York 10022
212-527-7700

Docket No: 9386/1F566US1

Box PATENT APPLICATION
Assistant Commissioner for Patents
Washington, DC 20231

Sir:

Enclosed please find an application for United States patent as identified below:

Inventor/s (name ALL inventors): Albhy GALUTEN; Peter WILLIAMS

Title: A Method and System for Handling Errors in a Distributed Computer System

including the items indicated:

1. Specification and 6 claims: 1 indep.; 5 dep.; _ multiple dep.

2. [] Executed declaration and power of attorney
   [X] Unexecuted declaration and power of attorney

3. [X] Formal drawings, 2 sheets (Figs. 1-2)
   [] Informal drawings, _ sheets (Figs.)

4. [] Assignment for recording to:

5. [] Verified Statement Claiming Small Entity Status

6. [] Check in amount of $.00, ($ filing; $ recording)
(See attached **Fee Computation Sheet**)

7. [] Preliminary Amendment.

Priority is claimed for this application, corresponding application/s having been filed as follows:

Country:	US
Number:	60/131,412
Date:	April 28, 1999

The priority documents [] are enclosed
[X] will follow.

Date: April 27, 2000

Respectfully submitted,

Pierre R. Yanney, Esq.
Reg. No. 35,418
Attorney for Applicant(s)

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9386/1F566

A METHOD AND SYSTEM FOR HANDLING ERRORS IN A DISTRIBUTED COMPUTER SYSTEM

This application claims the priority of U.S. provisional patent application No. 60/131,412 filed April 28, 1999, which is incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to tracking and responding to errors in a distributed electronic system.

BACKGROUND OF THE INVENTION

Application programs are typically designed to be self-contained, each having its own capacity for handling errors that may occur during the execution of the program. With the growing popularity of operating multiple programs simultaneously, much of the code for and processing of error messages in each program is redundant and therefore, inefficient. Furthermore, with the ever increasing use of the Internet, many applications operating locally use networked resources. Some applications use a central resource to provide automated help to users connected to the Internet.

What is needed is a system that handles the error messaging and error processing in an efficient manner for applications executed on distributed systems. The present invention satisfies this and other needs.

SUMMARY OF THE INVENTION

The present invention is a method and system for tracking and processing errors in a distributed computer system in which a centralized error processing utility handles errors generated by one or more applications. Specifically, as an application encounters an error, the present invention intercepts and assumes the processing of that error event. This global error processing is facilitated by the distributed network connecting the applications running on various user computers. Upon receipt of an error message from an application, the system creates an informative error package, propagates appropriate error alert to relevant subsystems, and attempts to resolve the error. The error may be resolved in various ways. For example, the system may select and dispatch appropriate help information to the user; or the system may locate an alternative resource to substitute for the failed resource. The system may prioritize errors when there is more than one error still unresolved at any given time. In addition, the system may filter errors that require different levels of response and the system may direct errors to resources capable of assisting in resolving the error.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram showing the preferred embodiment of the present invention; and

Figure 2 is a flow chart showing the method of the preferred embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In the preferred embodiment of the present invention, the system creates error messages, propagates alerts and resolves errors that arise in the course of operation of a computer system. The system in accordance with the preferred embodiment may be an independent, self-contained program, operating on errors occurring in other computer programs. Alternatively the present system may be part of another computer program, typically, a large program having many sub-systems. The system is especially suitable for use with a network of computer systems where various applications or sub-systems may be operating simultaneously on different computers across the network, some operating independently and others operating cooperatively. However, the system and method of the present invention are generally applicable to computer systems, ranging from stand-alone computers to larger global computer networks. The term *system element* is used herein to refer to the broad range of computer programs and sub-systems that may be subject to the present invention, i.e., programs which generate errors. System elements include, for example, applications programs, sub-programs, operating systems, communication protocols, and drivers for peripherals. In addition, the term *user* refers to a party using an application but may also refer to the operator or monitor of a system element(s).

Typically, in modern programming, each system element is designed to handle exceptional conditions (such as expecting a message from another module, or trying to access a common resource which is unavailable), with an error message that is used in program debugging or is passed to an error handling routine that provides diagnostic information or user feedback. For

example, within an application program, the error handling and debugging subsystems generate a specific error message associated with an unpredictable or unstable state within the application. The occurrences of errors are uniquely identified within the application program creating them, usually through a numbering or naming schema. In addition, programs typically log each error to a log file for diagnostic or audit purposes.

There are numerous different types of errors that may occur in a system element. For example, some errors may affect the internal logic of an application program such that the program is unable to undertake the task(s) that were requested and it exits this state in either a stable or unstable form. Other errors affect only the operation of that system element and are reported to the user. Still other errors affect the operation of other system elements, for example, when the application program that experienced the error is in communication with other system elements synchronously or asynchronously. In this case the error may cause a number of system elements to exit the functions being undertaken either in a stable or unstable form.

CREATION

A central resource creates an error information package based on a signal received from a system element indicating the occurrence of an error, e.g., an error message generated by an application program. Referring to Figure 1, the error routing server (16) is a computer or utility designed to be utilized by multiple applications and/or network computers. The error routing server acts as a clearinghouse directing incoming error messages and outgoing responses. As indicated by the arrows, error messages (12) generated by system elements (10) are sent to the error routing server (16). The error routing server (16) may then forward the error message (12) to the error

resource server (18), which is a computer or utility designed to implement the central resource that processes errors as described herein. The error resource server (18) may use the error FAQ server (20) to obtain information responsive to the error being processed. Additionally, the error resource server (18) may have access to one or more databases offering a variety of assistance options responsive to errors. In addition, the error routing server (16) may forward incoming error messages (12) to an error filter (14) and escalate these errors. The error filter may separate errors of different types and instruct the error routing server where each error message should be sent for processing. Finally, these components provide assistance and/or resolve the error by sending, by way of the error routing server (16), an appropriate response or instruction to the system element (10) experiencing the error. The operation of these components is discussed in more detail in connection with Figure 2.

Referring to Figure 2, in the event of an error during the processing of a system element, the present invention intercepts the element's processing of the error or the system element generates an error message for onward transmission. At step 24, the system element determines whether the user is actively connected to the network. If the user is not actively connected to the network, at step 28, the error message may be sent to a local error management system if present and/or queued for later transmission. If at step 24, it is determined that the user is online, the process proceeds with step 26. At step 26, the element's error message is transmitted to a central resource for processing. The central resource may reside locally or on another area network computer or the Internet. The error may be formatted in a tamper resistant or secure format before transmission to the central resource. The central resource may be located remotely and connected via a distributed network such as the Internet. Generally, the error message is transmitted as the user is experiencing

the error condition when using a complete network system with many points of failure.

At step 30, the central resource generates an error information package (error pack) based on the received error message. Each error pack may be identified by an error code, which may be a unique number for every occurrence of an error, or may also indicate the type of error as well. Sufficient additional information may be included in the error package to generate some provision of assistance to the user. For example, each error pack may include an identification of the application and/or subsystem element experiencing the error; a time stamp indicating the time that the error pack was created or the time that the error occurred; and an address indicating the location of the user (e.g. IP address, MAC address, or email address). A priority code may be included to indicate the priority of the error. The priority may range, for example, from terminal, such as a system failure of the specific program, to a service disconnect where the error is a completed function or operation. An indication of the internal state of the program or system element may also be included in the error pack in order to allow other system elements to adjust their response to this state. The internal state indicates the state of the application or subsystem experiencing the error, and enables the external system elements to adapt their responses to this situation.

In addition to generating an error information package, at step 32, the central resource dispatches to the originating application, or user, a help page or other dynamically updated help information. In this manner the user receives timely assistance as to the potential cause of the problem. The help message may direct the user to FAQ type pages associated with the problem at hand. In addition, the help message may generate an automatic help "bot" or wizard that assists the user through a number of scenarios to try to identify or clear the problem. A "bot" (as in robot) is

a program used on the Internet that performs repetitive functions such as posting a message to multiple newsgroups or searching for information. These scenarios may be dynamic in that they respond to user input and/or additional error or system messages that are generated within the process.

Error messages received by the central resource may be grouped by their identifying number and processed either automatically or manually to update the knowledge base and associated assistance provided to the user. The error information package may be provided in a secure format and sent to the relevant system resource.

PROPAGATION

Having generated an error information package, at step 34, the central resource propagates relevant information to any subsystem or program that may benefit from knowing about the occurrence of an error. The error information package may be sent to a corresponding web based error management resource. In addition, depending on the type of the error, error alert messages may be generated and propagated throughout the system. These messages are designed to create system alerts that indicate the system itself is experiencing a problem, such as a complete element failure or communications outage. Errors such as timeouts from delivery systems may in fact be used to dynamically switch those users from the resource that encountered the time out to another resource either locally or remotely.

The propagation of error alert messages to additional system elements may also cause the system to respond in a different manner depending on the nature of the error(s). The errors from one system element may cause a different system element to respond differently by potentially

resetting another element or providing an instruction to another to act upon. This depends on the circumstances and architecture of each particular system. The error alert propagation provides the basis for integration of error handling into a comprehensive customer care solution that includes the network and supporting infrastructure.

RESOLUTION

The creation and propagation of the error information package and error alert messages may have a significant impact on the perceived and realized customer service. However, the ultimate goal is to resolve the error. The central resource therefore analyzes the error and provides a timely response to the user, even if that response only acts to inform the user of the problem they are experiencing.

Analyzing errors involves identification and evaluation of each error individually and/or in combination with other errors. Errors may be identified by the combination of information provided by the error information package. For example, based on the locations and internal state, the central resource may be able to assist in evaluation of the error and increase the likelihood of effective resolution.

During the course of operation of the underlying system elements, many errors may occur contemporaneously and for any given error there may be errors that occurred earlier in time that are not yet resolved. To handle the numerous errors that may remain outstanding at any given time, at step 36, the system may utilize an error routing server (16) to prioritize the processing of errors. The error routing server identifies those errors that present the most significant threat to the continued operation of an underlying system element. The routing server may take into account that

various system elements have varying degrees of relative importance. For example, the operating system or some primary program that manages many other programs are more crucial than their respective application programs or modules. The decision as to which errors present the most important threats may be dependent on the priority level set beforehand and then evaluated through a series of rules. These rules may be initially defined, though over time these may be automatically updated and modified as a history of errors and failures develops. The routing server may also take into account that some errors may be related and should be handled jointly. Processing errors from various system elements at the central resource creates the ability to aggregate these errors and to provide alerts as to the problems with a primary system element, e.g., the failure of one or more delivery services or crucial pipes that are relied upon for other mission critical infrastructure.

One way in which the system evaluates an error is to confer with a database of error related information (step 38). The database may contain a history of past errors with suggestions as to resolutions of those errors. The database may contain a compilation of frequently occurring errors or frequently asked questions that may guide the system in resolving the instant error. The FAQ server may utilize common techniques to aggregate the errors and their causes, which may be indexed by both cause and error identification numbers. New FAQs may be created from the Error Resource Server, once the errors have been aggregated or associated with specific problems within the system elements.

The Error Resource Server is the repository of all the errors that are produced by the system. The Error Resource Server may hold the representation of the system architecture with each interface of the system elements, and can use these interfaces as the mechanism to categorize the errors received. The errors may be classified as either internal to a system element or external to an

element. The definition of errors can include an identification of the system element and the relationship of the error to that system element, or other system elements. Errors can be related to each other in an object model using commonly known Object Modeling techniques, including, but not limited to, inheritance, pre and post conditions and attributes. Further details of such Object Modeling may be found in Meyer, "Object Oriented Software Construction" (Prentice Hall), the contents of which are incorporated herein by reference. The identification of the relationship between errors and the treatment of these as individual objects within a systematic model provides the core of the Error Resource Server. The mapping of the relationships of the errors to the system interface model provides the framework for the errors to be classified and accessed by the rest of the system.

The Error Resource Server provides the data resource for the rest of the error system, and acts as the repository from which the other system elements obtain their baseline information. This enables other system elements to provide an efficient and timely response to system errors, while at the same time maintaining a contemporaneous error management resource and management system that supports the operations of the systems. In this model, the errors that occur become part of the customer care method which enables the efficient operation of the system as a whole. In this way, errors become homogenous within the system operation as a whole. By using these resources the central resource may be able to identify the underlying problem causing an error or group of errors. Having identified a problem, the resource may proceed to address the problem if possible.

Since there are many different possible errors and problems, the central resource filters errors according to the types of response or remedy required. Such filtering is accomplished by an error filer (14). At step 40, the filter may separate out those errors that cannot be resolved

without some physical change or human intervention. For example, an error caused by insufficient local disk space typically requires the user to delete some files creating available disk space or to add or replace disk space. Some errors may be filtered out and redirected for further processing. For example, an error that requires another system element to take action to resolve the issue may be redirected to the other system element. Another example is where a collection of system elements taken as a whole is dependent on external infrastructure or services provision that encountered a failure. In such an instance, the error may be redirected to the external element.

The error information packages generated by the central resource are well suited to importation into network management systems, which may be used for error management, monitoring, escalation and ultimately customer care.

In this way, the system and method of the invention handle errors by creating error information packages, propagating an error alert messages, and resolving the errors. It should be understood that the creation, propagation, and resolution functions may be performed either serially or in parallel, and may be performed by the same module or different modules. Additional functions such as dispatching assistance to handle the error, prioritizing the various errors, and applying the error filter, may similarly be performed in a different order or by one or more different modules, depending on the particular application.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A method for tracking and processing errors in a distributed computer system, the method comprising the following steps:

utilizing a centralized error detection system to intercept an error event from one of a plurality of applications;

upon the interception of an error message from one of said applications, creating an informative error package;

propagating appropriate error alerts to relevant subsystems, and

resolving the error.

2. The method of claim 1, wherein the resolving step includes the further steps of selecting and dispatching appropriate help information to the user.

3. The method of claim 1, wherein the resolving step includes the further step of locating an alternative resource to substitute for a failed resource associated with the intercepted error.

4. The method of claim 1, further comprising the step of prioritizing errors when there is more than one error still unresolved at any given time.

5. The method of claim 1, further comprising the step of filtering errors that

require different levels of response.

6. The method of claim 1, further comprising the step of directing errors to resources capable of assisting in resolving the error.

ABSTRACT

A method and system for tracking and processing errors in a distributed computer system. As an application encounters an error, a centralized system intercepts and assumes the processing of that error event. The central error processing may be used with a distributed network connecting the applications running on various user computers. Upon receipt of an error message from an application, the system creates an informative error package, propagates appropriate error alert to relevant subsystems, and attempts to resolve the error. The error may be resolved in various ways. For example, the system may select and dispatch appropriate help information to the user; or the system may locate an alternative resource to substitute for the failed resource. The system may prioritize errors when there is more than one error still unresolved at any given time. In addition, the system may filter errors that require different levels of response and the system may direct errors to resources capable of assisting in resolving the error.

Fig 1. . . .

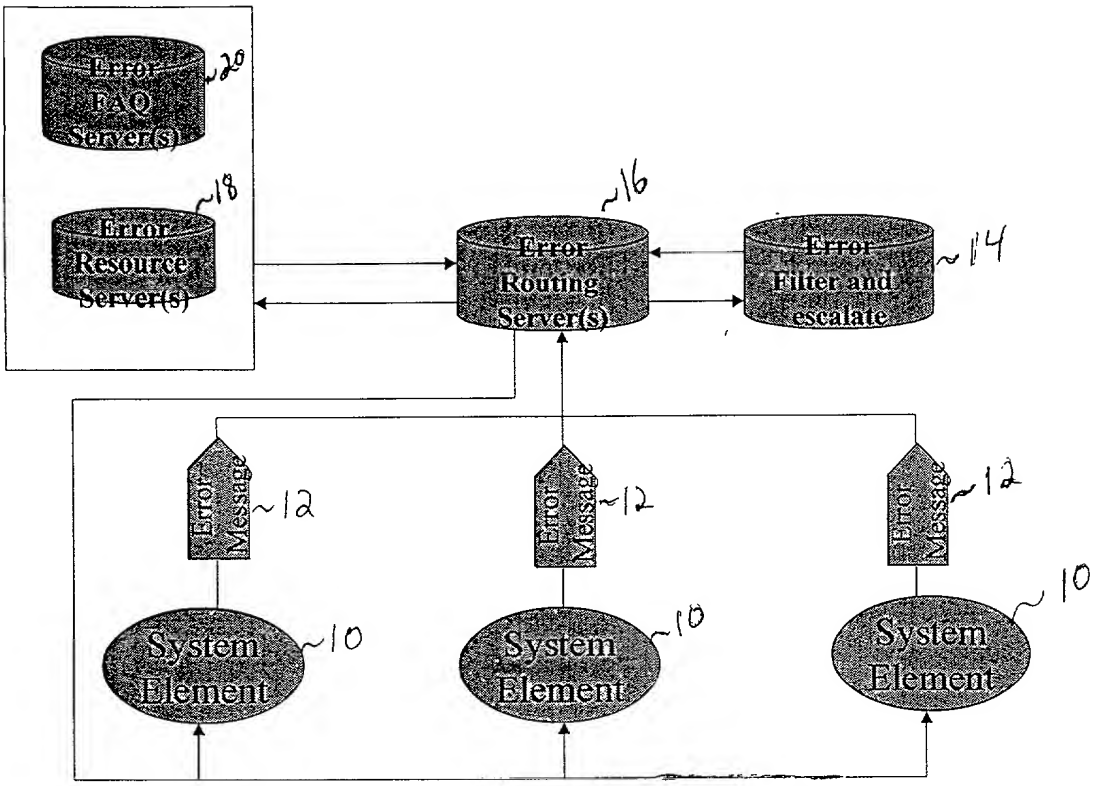
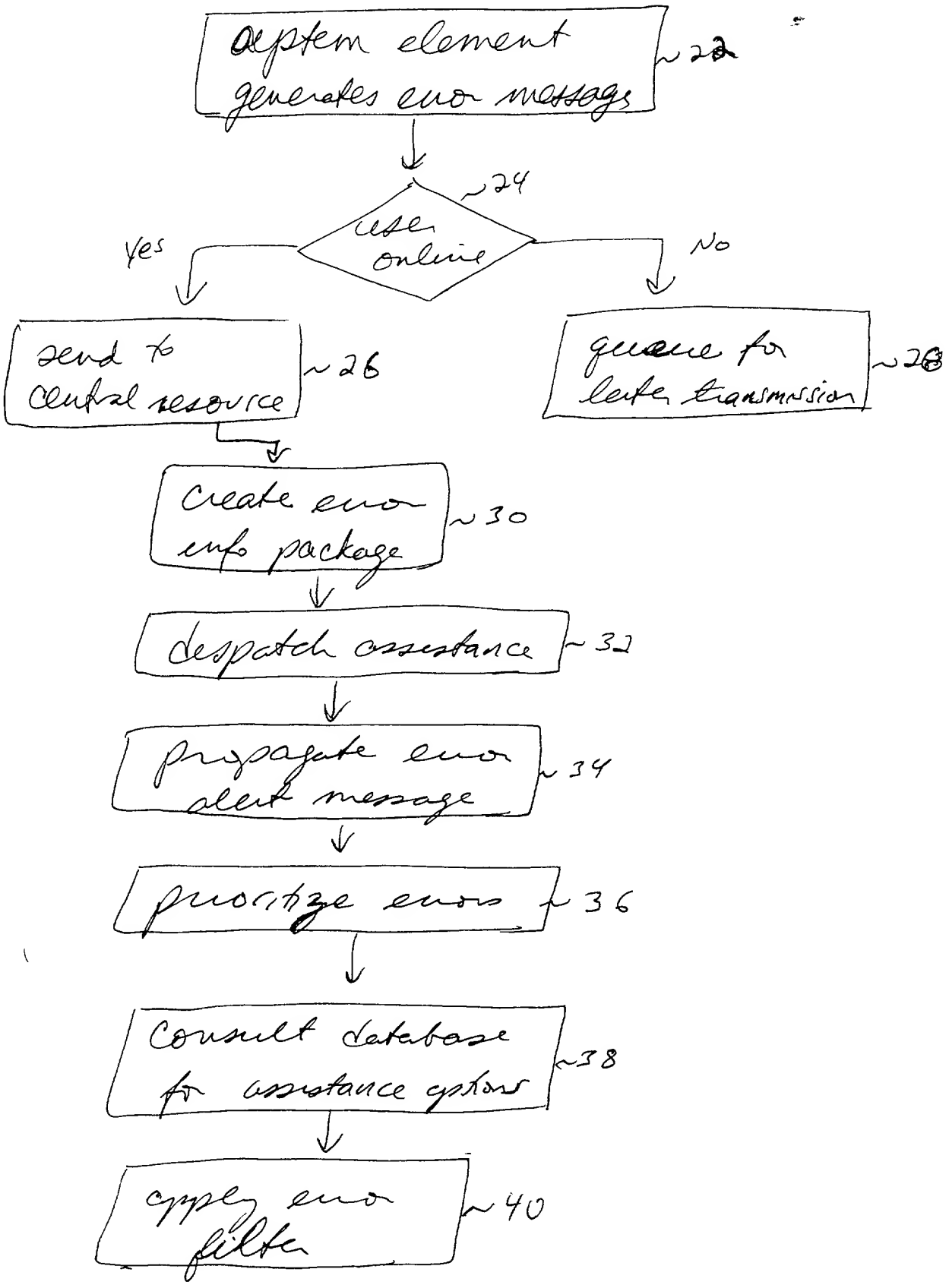

Error FAQ Server(s)
20
Error Resource Server(s)
18
Error Routing Server(s)
16
Error Filter and escalate
14
Error Message
12
Error Message
12
Error Message
12
System Element
10
System Element
10
System Element
10

Fig. 2


system element generates error message
22
24
user online
Yes
No
send to central resource
26
queue for later transmission
28
create error info package
30
despatch assistance
32
propagate error alert message
34
prioritize errors
36
Consult database for assistance options
38
apply error filter
40

Docket No.: 9386/1F566-US1

DECLARATION
AND POWER OF ATTORNEY
Original Application

As a below named inventor, I declare that the information given herein is true, that I believe that I am the original, first and sole inventor if only one name is listed at 1 below, or a joint inventor if plural inventors are named below, of the invention entitled:

A METHOD AND SYSTEM FOR HANDLING ERRORS
IN A DISTRIBUTED COMPUTER SYSTEM

which is described and claimed in:

[x] the attached specification or

[] the specification in application Serial No.filed
(for declaration not accompanying appl.)

that I do not know and do not believe that the same was ever known or used in the United States of America before my or our invention thereof or patented or described in any printed publication in any country before my or our invention thereof, or more than one year prior to this application, or in public use or on sale in the United States of America more than one year prior to this application, that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months prior to this application, that I acknowledge my duty to disclose information of which I am aware which is material to patentability in accordance with 37 CFR §1.56. I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I hereby claim the priority benefits under 35 U.S.C. §119 of any application(s) for patent or inventor's certificate listed below. All foreign applications for patent or inventor's certificate on this invention filed by me or my legal representatives or assigns prior to the application(s) of which priority is claimed are also identified below.

PRIOR APPLICATION(S), IF ANY, OF WHICH PRIORITY IS CLAIMED

COUNTRY	APPLICATION NO.	DATE OF FILING
US	60/131,412	28 April 1999

ALL FOREIGN APPLICATIONS, IF ANY, FILED PRIOR TO THE APPLICATION(S) OF WHICH PRIORITY IS CLAIMED

COUNTRY	APPLICATION NO.	DATE OF FILING

POWER OF ATTORNEY:

As a named inventor, I hereby appoint the following attorney(s) and/or agents(s) to prosecute this application and transact all business in the Patent and Trademark office connected therewith: Gordon D. Coplein #19,165, William F. Dudine, Jr. #20,569, Michael J. Sweedler #19,937, S. Peter Ludwig #25,351, Paul Fields #20,298, Marc S. Gross #19,614, Harold E. Wurst #22,183, Joseph B. Lerch #26,936, Melvin C. Garner #26,272, Ethan Horwitz #27,646, Beverly B. Goodwin #28,417, Adda C. Gogoris #29,714, Martin E. Goldstein #20,869, Bert J. Lewen #19,407, Henry Sternberg #22,408, Robert A. Green #28,301, Peter C. Schechter #31,662, Robert Schaffer #31,194, David R. Francescani #25,159, Robert C. Sullivan, Jr. #30,499, Ira J. Levy #35,587, Joseph R. Robinson #33,448; Pierre R. Yanney #35,418

all of the firm of DARBY & DARBY P.C., 805 Third Avenue, New York, NY 10022

SEND CORRESPONDENCE TO:	DIRECT TELEPHONE CALLS TO:
DARBY & DARBY P.C. 805 Third Avenue New York, NY 10022	Pierre R. Yanney, Esq. 212-527-7700

FULL NAME AND RESIDENCE OF INVENTOR 1

LAST NAME: GALUTEN FIRST NAME: Albhy MIDDLE NAME:

CITY: Santa Monica STATE OR FOREIGN COUNTRY: California COUNTRY OF CITIZENSHIP: U.S.A.

POST OFFICE ADDRESS: 525 West Rustic Road CITY: Santa Monica STATE OR COUNTRY: California ZIP CODE: 90402

FULL NAME AND RESIDENCE OF INVENTOR 2

LAST NAME: WILLIAMS FIRST NAME: Peter MIDDLE NAME:

CITY: Sydney STATE OR FOREIGN COUNTRY: Australia COUNTRY OF CITIZENSHIP: AUSTRALIA

POST OFFICE ADDRESS: 33/57 Darlinghurst Road, Potts Point CITY: Sydney STATE OR COUNTRY: Australia ZIP CODE: 2011

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001

of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 1: ______________________ DATED: ____________
Albhy GALUTEN

SIGNATURE OF INVENTOR 2: ______________________ DATED: ____________
Peter WILLIAMS

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